

1.2 Reacting Masses & Volumes

Question Paper

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| Course | DP IB Chemistry |
| Section | 1. Stoichiometric Relationships |
| Topic | 1.2 Reacting Masses & Volumes |
| Difficulty | Hard |

Time allowed: 20
Score: /12
Percentage: /100

Question 1

A periodic table is needed for this question

When a 1.00 g sample of carbon is burned in a limited supply of oxygen, 0.72 g of the carbon combusts to form CO_2 and 0.28 g of the carbon combusts to form CO .

These gases were passed through excess $\text{NaOH}(\text{aq})$ which absorbs the CO_2 , but not the CO . The remaining gas was then dried and collected.

Assuming that all gas volumes were taken at 25°C and 100 kPa pressure, what was the volume of gas at the end of the reaction? (Molar Volume of a gas at rtp = 24 dm^3)

- A 0.01 dm^3
- B 100 cm^3
- C 2.40 dm^3
- D 240 cm^3

[1 mark]

Question 2

A periodic table is needed for this question

Chicken eggs are made up of 5% by mass of egg shell. The average egg has a mass of 50 g.

Assume that chicken eggshell is pure calcium carbonate.

How many complete chicken's egg shells would need to neutralise 50 cm³ of 2.0 mol dm⁻³ ethanoic acid?

- A** 4
- B** 3
- C** 2
- D** 1

[1 mark]

Question 3

A periodic table is needed for this question

When a sample of potassium oxide, K_2O , is dissolved in 250 cm^3 of distilled water, 25 cm^3 of this solution is titrated against sulfuric acid with a concentration of 2.00 mol dm^{-3} . Complete neutralisation takes place with 15 cm^3 of sulfuric acid.

What is the mass of the original sample of potassium oxide dissolved in 250 cm^3 of distilled water?

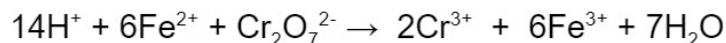
- A** $\frac{0.015 \times 250 \times 94.20}{25}$
- B** $\frac{2.00 \times 0.015 \times 94.20}{25}$
- C** $\frac{2.00 \times 0.015 \times 250 \times 94.20}{25}$
- D** $\frac{2.00 \times 0.015 \times 25 \times 94.20}{250}$

[1 mark]

Question 4

A periodic table is needed for this question

Iron and chromium can be made into an alloy called ferrochrome. Ferrochrome can be dissolved in dilute sulfuric acid to produce FeSO_4 and $\text{Cr}_2(\text{SO}_4)_3$. The FeSO_4 reacts with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ as shown in this equation:



When 1.00 g of ferrochrome is dissolved in dilute sulfuric acid and then titrated, 13.1 cm^3 of 0.100 mol dm^{-3} $\text{K}_2\text{Cr}_2\text{O}_7$ is needed for the complete reaction.

In the sample of ferrochrome, what is the percentage by mass of Fe?

- A** $\frac{13.1 \times 0.1 \times 6 \times 55.85 \times 100}{1000 \times 1}$
- B** $\frac{13.1 \times 0.1 \times 6 \times 55.85}{1000}$
- C** $\frac{13.1 \times 0.1 \times 55.85 \times 100}{1000 \times 1}$
- D** $\frac{13.1 \times 0.1 \times 6 \times 55.85 \times 1000}{100 \times 1}$

[1 mark]

Question 5

10 cm³ of methane and 10 cm³ of ethane were sparked with an excess of oxygen. Once cooled, the remaining gas was passed through aqueous potassium hydroxide, which absorbs carbon dioxide.

Assume all measurements were taken at 25°C and 1 atm pressure.

What volume of gas is absorbed by the alkali?

- A 45 cm³
- B 30 cm³
- C 20 cm³
- D 10 cm³

[1 mark]

Question 6

A solution of Sn²⁺ ions will reduce MnO₄⁻ ions to Mn²⁺ ions when acidified. The Sn²⁺ ions are oxidised to Sn⁴⁺ ions in this reaction.

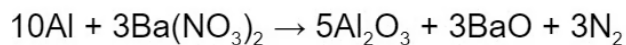
How many moles of Mn²⁺ ions are formed when a solution containing 18.96 g of SnCl₂ (M_r: 189.60) is added to an excess of acidified KMnO₄ solution?

- A 0.010
- B 0.015
- C 0.040
- D 0.050

[1 mark]

Question 7

Some fireworks can use the reaction between aluminium powder and anhydrous barium nitrate as a propellant. Metal oxides and nitrogen are the only products when this happens.



When 0.783 g of anhydrous barium nitrate (M_r 261.35) reacts with an excess of aluminium what is the volume of nitrogen produced in cm^3 ?
(Molar volume of a gas = 24 dm^3)

- A** $\frac{0.783 \times 24 \times 3}{261.35}$
- B** $\frac{261.35 \times 24000}{0.783 \times 1000}$
- C** $\frac{261.35}{0.783 \times 24000}$
- D** $\frac{0.783 \times 24000}{261.35}$

[1 mark]

Question 8

A periodic table is needed for this question

Excess acidified potassium dichromate(VI) was mixed with 2.76 g of ethanol. The reaction mixture was then boiled under reflux for one hour. Once the reaction had completed, the organic product was collected by distillation.

The yield of the product was 75.0%

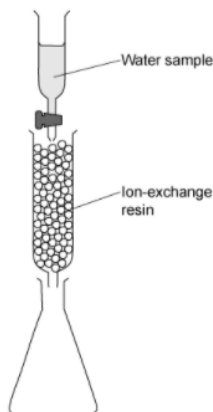
What is the mass of the product collected?

- A** $\frac{2.76 \times 60.06}{46.08}$
- B** $\frac{75 \times 2.76 \times 60.06}{100 \times 46.08}$
- C** $\frac{100 \times 2.76 \times 60.06}{75 \times 46.08}$
- D** $\frac{75 \times 2.76 \times 46.08}{100 \times 60.06}$

[1 mark]

Question 9

The concentration of calcium ions in a sample of water can be determined by using an ion-exchange column, shown in the diagram below:



A 50 cm^3 sample of water containing dissolved calcium sulfate was passed through the ion-exchange resin.

Each calcium ion in the sample was exchanged for two hydrogen ions. The resulting acidic solution collected in the flask required 25 cm^3 of $1.0 \times 10^{-2} \text{ mol dm}^{-3}$ potassium hydroxide for complete neutralisation.

What was the concentration of the calcium sulfate in the original sample?

- A** $\frac{0.050 \times 1.0 \times 10^{-2}}{2 \times 0.025}$
- B** $\frac{0.025 \times 1.0 \times 10^{-2}}{0.050}$
- C** $\frac{25 \times 1.0 \times 10^{-2}}{2 \times 0.050}$
- D** $\frac{0.025 \times 1.0 \times 10^{-2}}{2 \times 0.050}$

[1 mark]

Question 10

A tube of volume 0.3 dm^3 is filled with a gas at 27°C and 100kPa , the mass of the tube increases by $1.01 \times 10^{-3} \text{ kg}$.

Assume the gas is obeying the ideal gas laws.

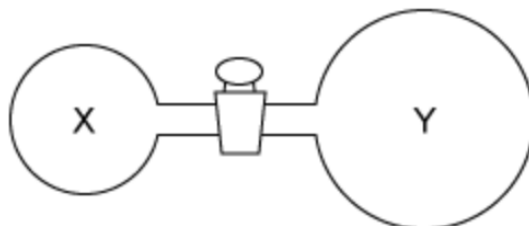
If M_r is the Molar mass of the gas, what is the mass of this sample of gas?

- A** $\frac{100000 \times 0.0003}{8.314 \times 27 \times M_r}$
- B** $\frac{100 \times 0.0003 \times M_r}{8.314 \times 300}$
- C** $\frac{100000 \times 0.3 \times M_r}{8.314 \times 300}$
- D** $\frac{100000 \times 0.0003 \times M_r}{8.314 \times 300}$

[1 mark]

Question 11

The glass containers X and Y are connected by a closed valve.



X contains pure CO_2 gas at $25\text{ }^\circ\text{C}$ and a pressure of $1 \times 10^5\text{ Pa}$. Container Y has been evacuated prior to the experiment and has a volume three times bigger than container X.

During the experiment, the valve is opened, and the temperature of the whole apparatus is raised to $160\text{ }^\circ\text{C}$.

What is the final pressure in the system?

A $\frac{1 \times 10^5 \times 160}{4 \times 25}$

B $\frac{4 \times 10^5 \times 433}{3 \times 298}$

C $\frac{1 \times 10^5 \times 433}{3 \times 298}$

D $\frac{1 \times 10^5 \times 433}{4 \times 298}$

[1 mark]

Question 12

Iodine is a shiny, black solid. Solid iodine sublimes easily when heated to produce a purple vapour.

A block of solid iodine is put into a closed container and completely sublimed to produce 1.3 dm^3 of iodine vapour. It is then kept at a constant temperature and pressure of 100 kPa .

The empty container had a mass of 3.22 g and when iodine was added the mass increased to 9.57 g . ($M_r \text{ I}_2 = 253.8$)

If iodine vapour acts as an ideal gas, what is the approximate temperature of the iodine vapour?

A
$$\frac{(9.57 - 3.22) \times 100000 \times 0.0013}{253.8 \times 8.314}$$

B
$$\frac{253.8 \times 100000 \times 0.0013}{(9.57 - 3.22) \times 8.314}$$

C
$$\frac{253.8 \times 100000 \times 1.3}{(9.57 - 3.22) \times 8.314}$$

D
$$\frac{253.8 \times 100 \times 0.0013}{(9.57 - 3.22) \times 8.314}$$

[1 mark]